MORPHOLOGY OF THE NORTHERN PLAINS IN THE CIRCUMPOLAR REGION, MARS. ***V.-P. Kostama***[1]**, *M. A. Kreslavsky***[2,3] and ***J. W. Head***[2], [1]Astronomy, Dept. of Physical Sciences, University of Oulu, Oulu, FIN-90014, Finland; [2]Dept. Geological Sci., Brown University, Providence, RI 02912-1846, USA; misha@mare.geo.brown.edu, [3]Astronomical Institute, Kharkov National University, Kharkov, Ukraine.

Introduction: The complex of polar deposits (the polar cap, its icy outliers and dune fields) at the North pole of Mars is surrounded by vast generally flat geologically homogeneous plains. These plains at high latitudes (>~55°) are covered with a thin geologically young material with specific decameter-scale surface texture [1, 2] containing much water ice [3, 4]. We refer this material as the high-latitude layer (HLL). High-resolution MGS MOC images [1] showed many circular features interpreted to be mantled craters [1] (see Fig. 118, 119 there). Our objective is to access geological processes that occurred in the region during the Amazonian, and the relative and absolute time scales of these processes, including those related to the origin of the shallow subsurface ice. To approach this goal, we studied the size-frequency distributions of circular features of different morphology, as well as peculiarities of the surface texture. We are carrying out a systematic survey of the high-resolution MOC images in the region. This work is in progress; here we report some preliminary observations.

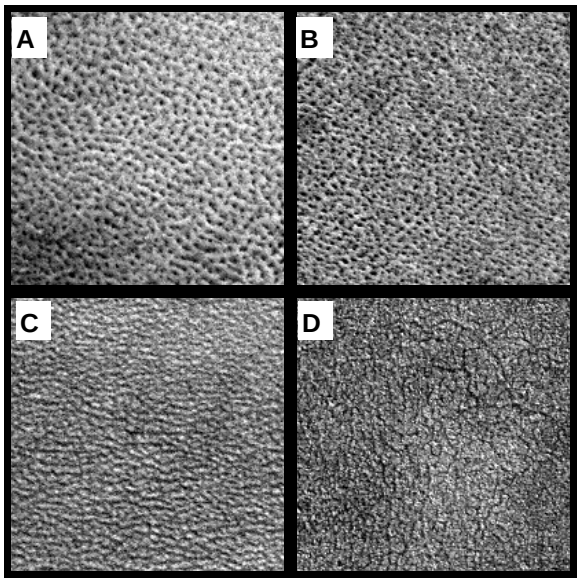

Fig. 1. Typical textures of the HLL in the northern plains: **A** - basketball texture, **B** – regular texture, **C** – wrinkle texture, **D** – polygonal texture. Portions of E01/01975, E04/00026, E01/01868, and E04/00028, respectively. Samples are 0.9 x 0.9 km, illumination is from lower left.

Survey: We systematically overview the HLL texture, study morphology and measure diameters of the circular features in the northern plains northward from 55°N using the narrow-angle MOC images. For the systematic survey we use images of 4.8 m/pix resolution. This resolution was chosen because a large number of such images were taken during cycles from E01 to E05, when observational conditions in the region were mostly good. For each image, we register the morphological types of HLL texture present in the image, and classify and measure all circular features from 50 m to 1 km. Although we try to do the survey as homogeneously as possible, the ability to identify the features and textures differ from image to image due to the differences in atmospheric scattering, illumination geometry, presence of contrasting albedo features on the scene, electronic settings of the camera, etc. Consequently, analyzing the survey results, we should be aware of possible latitudinal (illumination) and regional (albedo pattern) biases. Nevertheless, we are sure, that in the surveyed images we identified all fresh features larger than 50 m that disrupt the HLL.

Texture: In the northern plains, the HLL has very distinctive decameter-scale surface textures seen in the images (**Fig. 1)** The *"basketball" texture* (**A in Fig.1**; also Fig. 123 D, E in [1]) is the most typical and widespread one. The best highest-resolution (1.6 m/pix) low-sun images show that the knobs are dome-shaped, with the steepest slopes <6°. In some places, the knobs forming the basketball texture are organized into a highly coherent linear structures (**Fig. 1 B**, see also Fig. 123 in [1]) forming a *regular texture*. The *wrinkle texture* (**Fig. 1 C**) is also very common. The *polygonal texture* (**D**) occurs rarely and in relatively small patches (several km). Spatial scale of the textures differs from site to site, and often is smaller than shown in Fig. 1; the texture is often hardly distinguishable in the images.

Local variations of the patterns are often modulated by kilometer-scale topography. More pronounced basketball texture tends to occur in local lows. The wrinkle texture on slopes of km-scale knobs has a radial orientation.

There are latitudinal variations in the patterns. The regular texture tends to occur at higher latitudes. The polygonal texture occurs at high latitudes above 70ºN only. Wrinkle texture is rare in this high-latitude zone.

Modified circular features: Circular features in the northern plains have a wide range of morphologies from well-expressed impact craters covered with the textured HLL (**Fig. 2A)** to hardly distinguishable circu-

lar chains of lineaments and/or arcuate albedo markings (**Fig. 2B** upper left). The ability to distinguish features of the latter type strongly depends on the observational conditions and the presence and nature of the albedo markings on the surface. In addition, for such features it is not clear what should be considered as the feature diameter. When circular lineament chains were observed, we used the outermost circle for diameter measurements. If only albedo markings were seen, we used the inner arcuate albedo contrast, because in many cases where both lineaments and markings are present, the markings were outside the lineaments. Impact origin of features of this type is not completely clear. They are usually associated with local highs (gentle knobs forming the surface of the Vastitas Borealis Formation). We found a series of transitional morphologies between clearly expressed impact craters (Fig. 2A) and the subtle features, which can be considered as evidence for their impact origin.

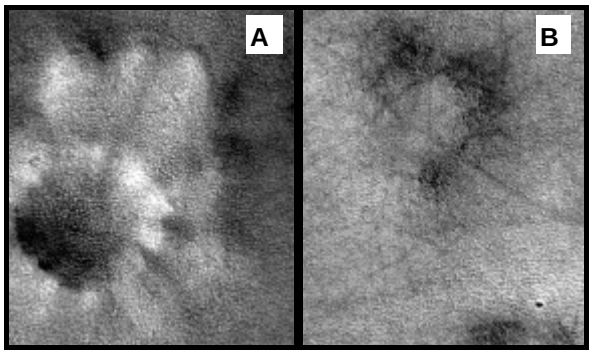

Fig. 2. Two portions of E02/01380, 1.4 km wide. Illumination is from lower left. B has 30% higher contrast than A. **A**, impact crater, covered with HLL. **B**, subtle circular feature in the upper left, fresh small impact crater (60 m) in the lower right.

The size-frequency distribution of all modified circular features is close to that should be expected for an accumulation population of the impact craters [5], with some shortage for small diameters, which is natural, taking into account strong degradation and alteration processes.

Fresh circular features: At the high latitudes (>70°N) the HLL is mostly intact, with some erosion and removal at the steepest slopes of large (>10 km) impact craters. So far, we identified 3 small circular features, almost certainly impact craters superposed on the HLL and somewhat degraded. Southward from ~55°N-60°N the HLL is often dissected and eroded. In the 55°N -70°N zone there is a number of examples where, where the HLL is cut by circular or quasi-circular fresh depressions. Some of such features clearly have collapse origin. There are several large clusters of pits, some of the pits in the clusters are fresh, but the majority of them are covered with the typically textured HLL (**Fig. 3**). The size-frequency distribution of the pits in the clusters is steeper than the impact crater production function. This means that the pits can hardly be the result of the impact crater degradation.

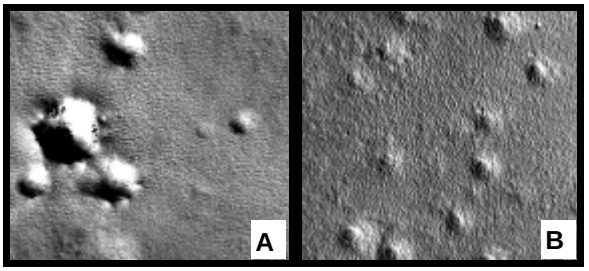

Fig. 3. A. Portions of E02/00200. A few pits; the largest one is a fresh collapse feature with steep slopes, others pits are covered with the HLL in different degrees. **B**. Portions of E02/01984. Pits covered with HLL. Small sharp feature in the upper right corner could be a fresh impact crater (40 m). Both images are 1.4 km wide; illumination is from lower left.

Several images at latitudes <70°N contain a set of small sharp circular depressions, apparently randomly scattered over the image; a few of them sometimes are larger than 50 m, other are smaller (see examples in **Fig. 2B, 3B**). This situation is very similar to that should be expected for an accumulating population of impact craters. There are a few tight pairs of small craters in such images, which is natural because of probable breakup of small projectiles in the atmosphere. The crater density calculated over several images with such probable impact crater population gives an age estimate on the order of 1 Myr, using the Neukum production function recalculated for Mars [5]. This estimate is highly uncertain, because (1) this is statistics of a few craters; (2) the recalculation of the production function is accurate within a factor of 2 [5]; (3) the extrapolation of the projectile flux established for 100s Myr time scale down to 1 Myr time scale is poorly grounded; (4) atmospheric attenuation of the projectile flux is uncertain.

There are many images in the lower latitudes (55°N - 60°N), where there are definitely no impact features. This observation suggests, that the crater retention age of the HLL in different locations differs at least by a factor of a few. See an accompanied abstract (by Kreslavsky and Head) for discussion.

References: [1] Malin M. C. and Edgett K. S. (2001) *JGR 106*, 23429-23570. [2] Kreslavsky M. A. and Head J. W. (2002) *GRL 29*, 10.1029/2002GL 015392. [3]. Tokar R. L. et al. (2002) *GRL, 29*, 10.1029/2002GL015691. [4] Boynton W. V. et al. (2002) *Eos Trans. AGU, 83*(47), Abstract # P11B-02. [5] Ivanov B. A. (2001) *Space Sci. Rev., 96*, 87.